# Homework 3 Stacks

1. Describe why a stack is not a suitable data structure for holding client records at a call centre. Suggest a more suitable data structure and justify why it is suitable. [3]

2. If a stack is implemented as a dynamic data structure, what bounds the number of items that can be pushed? [1]

3. The operation peek() returns the top item of a stack without removing it from the stack. What should happen if a peek() is attempted on an empty stack? [1]

4. Complete the following to show the state of a stack after the indicated operations. The stack can only hold 4 items in total. [5]

|  |  |  |  |
| --- | --- | --- | --- |
| **Instruction** | **Stack** | **Front** | **Result** |
| stack 🡨 new array(4) | [] | -1 |  |
| push(rabbit) |  |  |  |
| push(fox) |  |  |  |
| push(mouse) |  |  |  |
| peek() |  |  |  |
| pop() |  |  |  |
| pop() |  |  |  |
| push(hedgehog) |  |  |  |
| push(magpie) |  |  |  |
| push(badger) |  |  |  |
| isFull() |  |  |  |
| peek() |  |  |  |
| pop() |  |  |  |
| pop() |  |  |  |
| pop() |  |  |  |
| pop() |  |  |  |
| isEmpty() |  |  |  |

4 (a) Describe the role of the **call** **stack** and **stack frame** in relation to subroutine calls. [5]

(b) Figure 1 shows the skeleton of a program containing several subroutine calls.

Figure 1 Figure 2

|  |  |
| --- | --- |
| 100 | SUB subA(p1) |
| 101 | subB (p1, 4) |
| 102 | … |
| 199 | ENDSUB |
|  |  |
| 200 | SUB subB(p10) |
| 201 | x 🡨 12 |
| 202 | subC (p10, x) |
| 203 | … |
| 299 | ENDSUB |
|  |  |
| 300 | SUB subC (p1, p2) |
| 301 | … |
| 399 | ENDSUB |
|  |  |
|  |  |
| 500 | main() |
| 501 | p10 🡨 8 |
| 502 | subA(p10) |
| 503 | … |
|  |  |

|  |  |
| --- | --- |
| **Line** | **Stack** |
| 500 |  |
| 501 |  |
| 502 | [503] |
| 100 |  |
| 101 |  |
| 200 |  |
| 201 |  |
| 202 |  |
| 300 |  |
| 301 |  |
| 399 |  |
| 203 |  |
| 299 |  |
| 102 |  |
| 199 |  |
| 503 |  |

Complete the table in Figure 2 to show the state of the stack during these subroutine calls, using the notation [return address1, return address2, ..]

**Show only return addresses.**

The state of the stack at line 502 is given in the table. [5]

[Total 20 Marks]